

Applic. No. 10/646,206
Amdt. dated July 12, 2005
Reply to Office action of April 12, 2005

Remarks/Arguments:

Reconsideration of the application is requested.

Claims 1-21 remain in the application. Claims 3 and 13 have been amended.

In item 2 on page 2 of the above-identified Office action, claim 3 has been rejected as being indefinite under 35 U.S.C. § 112.

More specifically, the Examiner has stated that it is unclear what is meant by selecting the size "with" less than a quarter wavelength of various exposure lights. Claim 3 has been amended so as to facilitate prosecution of the application and is in line with the Examiner's suggestion. Therefore, the rejection is believed to have been overcome.

It is accordingly believed that the specification and the claims meet the requirements of 35 U.S.C. § 112, first and second paragraphs. Should the Examiner find any further objectionable items, counsel would appreciate a telephone call during which the matter may be resolved. The above-noted changes to the claims are provided solely for cosmetic or clarificatory reasons. The changes are not provided for

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overcoming the prior art nor for any reason related to the statutory requirements for a patent.

In item 4 on page 3 of the Office action, claims 1-5, 7-10, 12, 13, 16, 17, 20, and 21 have been rejected as being fully anticipated by Kusumoto et al. (EP 0 744 662) (hereinafter "Kusumoto") under 35 U.S.C. § 102.

In item 5 on page 4 of the Office action, claims 1-6, 10, and 16-20 have been rejected as being fully anticipated by Okumura et al. (U.S. Patent No. 5,744,293) (hereinafter "Okumura") under 35 U.S.C. § 102.

In item 6 on page 6 of the Office action, claims 1, 10, and 11 have been rejected as being fully anticipated by Nomura (U.S. Patent No. 6,384,318) under 35 U.S.C. § 102.

As will be explained below, it is believed that the claims were patentable over the cited art in their original form and the claims have, therefore, not been amended to overcome the references.

Before discussing the prior art in detail, it is believed that a brief review of the invention as claimed, would be helpful.

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Claims 1 and 20 call for, *inter alia*:

the nanocrystalline particles being configured to absorb light via the quantum size effect.

There are two different mechanisms for absorbing light in an antireflective layer. It is important to distinguish between these two mechanisms in order to discuss the prior art references.

A first mechanism of absorbing light (in an antireflective layer) is to provide a light absorbing substance in the material of the antireflective layer. The light absorbing substance may be provided in liquid form, as a component of a mixture of several liquid substances, or in solid form in the form of particles. In the case where light absorbing particles are used, the particle size may vary from very small particles in the nanometer scale to very large particles in the micrometer range. However, regardless of the particular state of aggregation of the light absorbing substance, light absorption according to the first mechanism takes place such that the energy absorption in the light absorbing substance occurs in conformity with the electronic band structure of the light absorbing substance itself. In this usual case of light

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absorption, no additional energy levels within band gaps are formed. Instead, the electrons of the light absorbing substance are excited and transferred to energy levels provided within the bands (not in the band gaps) of the respective light absorbing substance.

According to the second mechanism, the quantum size effect, light absorption occurs in a different manner. According to the quantum size effect, additional energy levels are provided in band gaps of a matrix substance due to the presence of nanocrystalline particles of appropriate particle material and appropriate particle size. The additional energy levels for excitation (and, as a consequence, for light absorption) are provided within band gaps that are between two bands of the electronic band structure. Furthermore, these additional energy levels are provided in band gaps of the matrix substance (not in band gaps of the particle material).

Light absorbing substances subject to the first mechanism (ordinary light absorption) are commonly used in the UV range as well as in the range of visible light. Additives absorbing light and/or reflecting light of a wavelength different than the wavelength of the light absorbed, are widely used. These additives are called "pigments" and are preferably used to achieve a colored appearance of different products.

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Such additives or "pigments" may be provided as particles, in particular, as nanocrystalline particles. Furthermore, light-absorbing substances subject to the second mechanism (the quantum size effect) may be provided as nanocrystalline particles as well. Accordingly, disclosure of nanocrystalline particles having a particle size less than 100 nm does not necessarily disclose that the material of the nanocrystalline particles is subject to the second mechanism of light absorption (quantum size effect). Instead, it depends on the respective material of the particles and the combination with the respective material chosen for the matrix substance surrounding the nanocrystalline particles as to whether the nanocrystalline particles absorb light via the quantum size effect by providing additional energy levels within band gaps of the matrix substance. Accordingly, any disclosure of light absorption subject to the quantum size effect involves disclosure of three conditions. The first condition is an appropriate matrix substance. The second condition is an appropriate size of nanocrystalline particles. The third condition is an appropriate particle material such as tin oxide or cadmium sulphide. In particular, it is the combination of an appropriate particle material and of an appropriate matrix substance, which enables quantum size effect to be achieved. This is because it is dependent on the

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matrix substance as to whether the additional energy levels are located on an energy scale within the bands or within the band gaps of the matrix substance.

The Examiner refers to Kusumoto, Okumura, and Nomura, which according to the Examiner disclose light absorbing particles subject to the second mechanism (the quantum size effect).

Some of these references pertain to semiconductor manufacture.

However, Kusumoto and Okumura do not disclose that the particles (which indeed may be smaller than 100 nm) are subject to the second mechanism (the quantum size effect).

The Examiner mainly referred to titanium oxide as a particle material disclosed on page 3, line 20 of Kusumoto. The Examiner seems to have referred to this, because of the fact that in claim 13 of the instant application, titanium oxide was disclosed as one of the possibilities for the nanocrystalline particles. Actually, however, according to the present invention (as disclosed in the original invention disclosure and in amended claim 13), titanium oxide is only used as a matrix substance (see claim 11) rather than as a particle material subject to the quantum size effect. It also appears that in Kusumoto the titanium oxide is subject to the first mechanism of light absorption, because of the titanium oxide. This is also the case with the large variety of alternative particle materials enumerated on page 3, lines 18

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to 21 of Kusumoto identified as "pigments" on page 3, line 17, which serve to give diverse products a colored appearance, which is apparent from names like "yellow lead", "zinc yellow", "rouge", "cadmium red", "titanium black" and "iron black" (see page 3, line 20). As already pointed out in the previous response dated February 1, 2005, it does not necessarily follow that disclosure of a particle size below 100 nm indicates that the particles, irrespective of the particle material, are subject to the quantum size effect.

As can be seen from the above-given comments, the Kusumoto reference does not show the nanocrystalline particles being configured to absorb light via the quantum size effect as recited in claims 1 and 20 of the instant application.

In Kusumoto, any disclosure of an appropriate matrix substance combined with an appropriate particle material enabling light absorption via the quantum size effect is absent.

Furthermore, due to the large variety of "organic solvents" enumerated on page 3, lines 31 to 47 of Kusumoto, it is very doubtful that all the enumerated organic solvents have an electronic band structure with band gaps located (on an energy scale) such that additional energy levels provided by the nanocrystalline particles are located within these respective band gaps. Finally, in view of the absence of any disclosure

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of the quantum size effect throughout Kusumoto, Kusumoto does not refer to the second mechanism of light absorption (quantum size effect).

As can be seen from the above-given comments, the Okumura reference does not show the nanocrystalline particles being configured to absorb light via the quantum size effect as recited in claims 1 and 20 of the instant application.

Okumura fails to disclose the quantum size effect. Okumura discloses "fine carbon particles" (column 3, line 33).

Although Okumura discloses a particle size of below 100 nm (column 3, line 50), Okumura does not disclose a particle material combined with an appropriate matrix substance for enabling the quantum size effect. Instead, Okumura discloses carbon particles and other particles giving products a black appearance (typical "pigments") subject to the first mechanism of light absorption. It is questionable why the Examiner assumes that the carbon particles are subject to the second mechanism of light absorption (the quantum size effect) in the absence of any explicit or implicit disclosure in Okumura thereof.

As can be seen from the above-given comments, the Nomura reference does not show the nanocrystalline particles being

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configured to absorb light via the quantum size effect as recited in claims 1 and 20 of the instant application.

Nomura does not disclose light absorption using the quantum size effect. Nomura only discloses silicon (silicon oxide) as a particle material (column 3, line 4) and particle sizes of below 100 nm (column 13, line 30). However, according to claim 11 of the instant application, silicon oxide is used as a matrix substance. Since a matrix substance is not subject to the quantum size effect, it appears that silicon oxide, if provided in form of particles, is only subject to light absorption via the first mechanism and not to light absorption via the quantum size effect.

In item 8 on page 6 of the Office action, claim 14 has been rejected as being fully anticipated by Kusumoto (EP 0 744 662) under 35 U.S.C. § 102 or in the alternative as obvious over Kusumoto (EP 0 744 662) under 35 U.S.C. § 103. Since claim 1 is believed to be allowable, dependent claim 14 is believed to be allowable as well.

In item 9 on page 7 of the Office action, claim 15 has been rejected as being obvious over Kusumoto (EP 0 744 662) in view of Yamada et al. (EP 0 770 579) (hereinafter "Yamada") under 35 U.S.C. § 103. Yamada does not make up for the deficiencies

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of Kusumoto. Since claim 1 is believed to be allowable,
dependent claim 15 is believed to be allowable as well.

Even though claim 15 is believed to be allowable, the following remarks pertain to Yamada. Yamada only discloses that the quantum size effect is well known. However, Yamada does not disclose that the quantum size effect is used an antireflective layer on an integrated semiconductor device. Instead, Yamada only discloses the use of the quantum size effect in macroscopic products for conventional use, which is already described in the present application (page 3, second paragraph). In particular, Yamada discloses commercially available float glass sheets (page 7, line 57) or other glass articles (page 10, line 36). Prior to the present invention, combined nanocrystalline particle materials and matrix substances subject to the quantum size effect were not used in semiconductor manufacture. This is because only certain materials compatible with the diverse microelectronic processes steps (including heating steps, deposition steps, implanting and doping steps etc.) can be used in semiconductor manufacture. Therefore, it is not obvious that materials known from the manufacture of macroscopic products (like window glasses etc.) are compatible with the complex manufacture of integrated circuits.

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It is accordingly believed to be clear that none of the references, whether taken alone or in any combination, either show or suggest the features of claims 1 or 20. Claims 1 and 20 are, therefore, believed to be patentable over the art and since all of the dependent claims are ultimately dependent on claims 1 or 20, they are believed to be patentable as well.

In view of the foregoing, reconsideration and allowance of claims 1-21 are solicited.

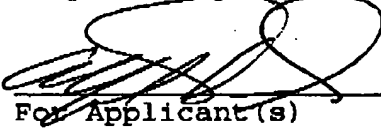
In the event the Examiner should still find any of the claims to be unpatentable, counsel respectfully requests a telephone call so that, if possible, patentable language can be worked out.

If an extension of time for this paper is required, petition for extension is herewith made.

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Please charge any other fees which might be due with respect
to Sections 1.16 and 1.17 to the Deposit Account of Lerner &
Greenberg P.A., No. 12-1099.

Respectfully submitted,


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